

# User Manual

## PU20 – Wide-Range PSU for 19" Railway Systems, 24 to 110 VDC, 120 W



## **PU20 – Wide-Range PSU for 19" Railway Systems, 24 to 110 VDC, 120 W**

The PU20 is a plug-in power supply unit for 19" systems (like VMEbus and CompactPCI® Serial). It is especially designed for computer systems in public transport vehicles and for harsh environments, like railway applications, making it suitable for both onboard and wayside use.

The PU20 has a nominal input power range of 24 V to 110 V with a max. input voltage range of 14.6 to 156 VDC (according to EN 50155 and S-9401). It also has an automatic input voltage range detection for 24, 72, 110 VDC, to define the under-voltage level. Additionally, the PU20 has a configurable voltage range for 36, 48, 74, 96 VDC, which is controlled by a rotary switch.

The standard output voltage is 5 V with a dynamic load sharing of between 12 and 5 V with 120 W. The output power at 3.3 V is 35 W, which is shared with the 5 V load. Switch-on behavior is independent of the load.

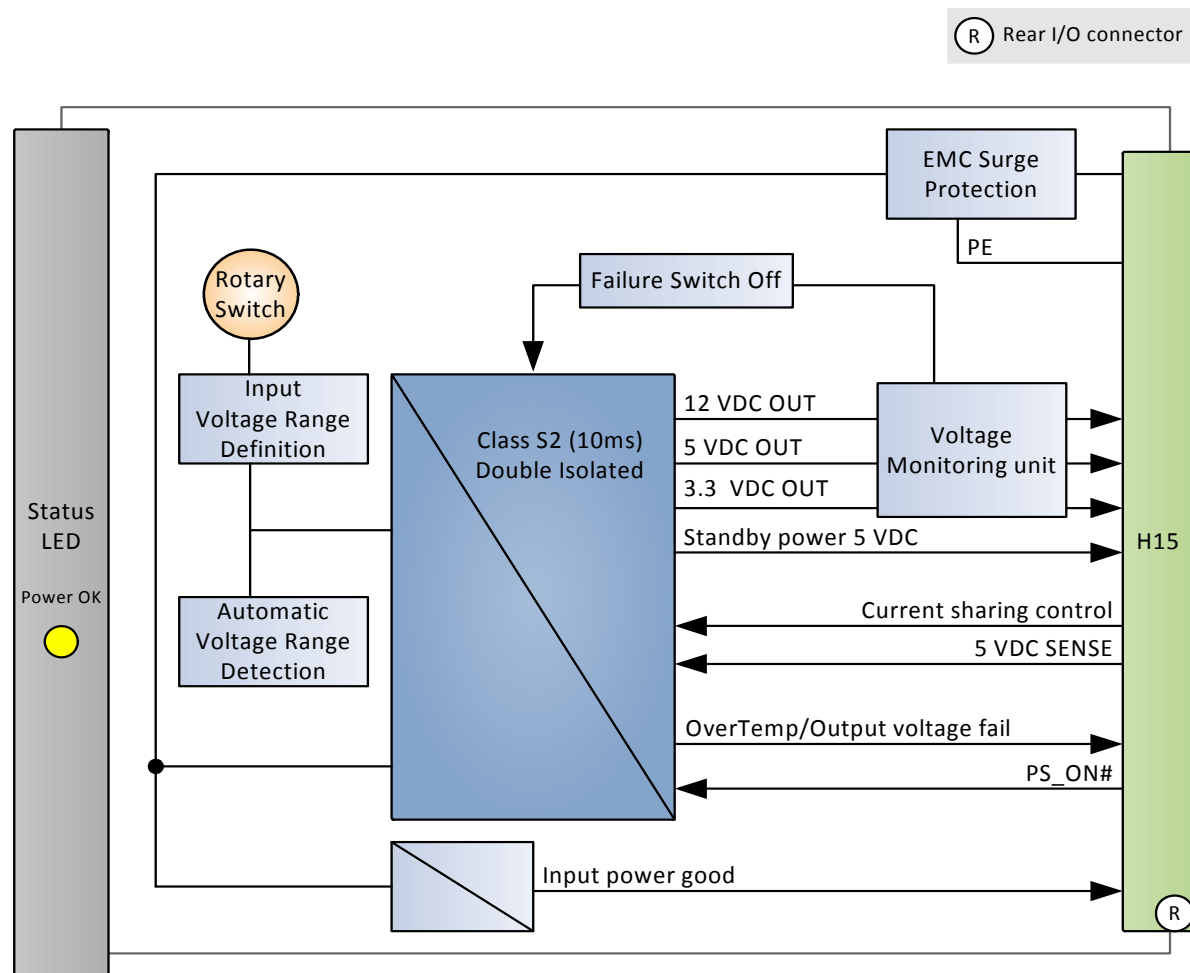
The PU20 also has a standby voltage of 5 V with 5W to supply the independent shelf controller, and to support wake-on-LAN functionality.

The PSU provides three ports, on the secondary side, for switching the output voltages. They also indicate the event of an input power failure, output voltage failure or a fail-over temperature.

The PSU is coated conformally, and all components are secured against vibration. When more power supplies run in parallel, the performance loss is shared evenly and, in case of a fault in one of the power supplies, the output power is removed completely so as to avoid any negative effects. The double power monitoring ensures that the output voltage is within the valid range. In case of error, the voltage is powered-down as prepared by the SIL applications. The thermal stress is extremely low due to integrated heat sinks, and diversion of dissipated heat over the mounting surface.

The PU20 is fully compliant with EN 50155, meeting all shock, vibration, EMC and isolation requirements. Operating under temperatures ranging from -40 to 70°C with increments to 85°C for 10 minutes (class TX), with a hold up time of 10 ms, as is in accordance with EN 50155 Class 2.

## Diagram



## Technical Data

### Input Characteristics

- Nominal voltage input: 24 V, 36 V, 48 V, 72 V, 96 V, 110 V (according to EN50155)
  - Max. input power range of 14.6 to 156 VDC
  - Automatic input voltage range detection for 24, 72, 110 VDC
  - Configurable voltage range for 36, 48, 74, 96 VDC
  - Power-on/-off threshold
- Input voltage range
  - Nominal input voltage of 74 VDC provided (according to S-9401)
  - Voltage range for 74 VDC is 20 to 130 VDC
- Power Variations
  - No functional disturbance with input voltage variations of:  $0.6 \times U_n < 1.4 \times U_n$  for 0.1 s
  - No functional disturbance with input voltage variations of:  $1.25 \times U_n < 1.4 \times U_n$  for 1 s
- Inrush current limiting

### Output Characteristics

- Output voltages: 12 VDC, 5 VDC and 3.3 VDC
- Standby output voltage: 5 VDC with a 5 W load
- Accuracy: Max.  $\pm 1\%$  of the nominal value
- Holdup time: 10 ms according to Class S2
- Dynamic load distribution
  - 120 W for complete temperature range without forced airflow
  - Load sharing between 12 VDC output and 5 VDC output, including 3.3 VDC

### Connection

- Type H15, DIN 41612 plug connector

### Control and Status Indicator

- Three ports on secondary side
  - Switches output voltages
  - Indicates input power failure, output voltage failure or fail-over temperature

### Parallel connection

- Up to six power supply units can be used in parallel
  - Extends availability (backup protection against faults)
  - Extends power
  - Increases performance
  - Ensures redundancy

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### **Miscellaneous**

- Overload and short circuit protection
- Standby voltage at power down, always available
- Reverse polarity protection for input voltage and short circuit
- Output voltage and temperature supervision
- Overtemperature and overvoltage shutdown
- Status LED on front panel

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### **Electrical Specifications**

- Isolation (according to EN 50155)
  - Input/output: 3100 VAC
  - Input/shield: 3100 VAC
  - Output/shield: 1000 VAC

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### **Mechanical Specifications**

- Dimensions: 3U, 5HP
- Integrated heat sink
- Weight: tbd

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### **Environmental Specifications**

- Temperature range (operation): -40 to +70°C (85°C/10 mins), no derating
- Temperature range (storage): -50 to +85°C
- Temperature: 70°C, with up to 85°C for 10 minutes according to class Tx (EN 50155)
- EMC Emission:
  - EN 55022: CISPR 22 – Class B
  - FCC 15.109 and S-9401
- EMC Immunity: EN 55024 – Class A
- Airflow: convection cooling
- Cooling test according to EN 60068-2-1
- Dry heat test according to EN 60068-2-2
- Shock: 50 m/s<sup>2</sup>, 30 ms (EN 61373)
- Vibration (function): 2.02 m/s<sup>2</sup>, 5 Hz to 200 Hz (EN 61373)
- Vibration (lifetime): 11.44 m/s<sup>2</sup>, 5 Hz to 200 Hz (EN 61373)

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### **MTBF**

- min. 600 000h @ 40°C according to IEC/TR 62380 (RDF 2000)

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### **Safety**

- Flammability
  - PCB manufactured with a flammability rating of 94V-0 by UL recognized manufacturers
- Electrical Safety
  - EN 60950-1
  - Insulation measurement test according to EN 50155 (12.2.9.1)
  - Voltage withstand test according to EN 50155 (12.2.9.2)

### **EMC Conformity**

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- EN 55011 (radio disturbance)
- IEC 61000-4-2 (ESD)
- IEC 61000-4-3 (electromagnetic field immunity)
- IEC 61000-4-4 (burst)
- IEC 61000-4-5 (surge)
- IEC 61000-4-6 (conducted disturbances)

## **Configuration Options**

### **Output voltage**

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- Available in two different models:
  - 14.4 VDC to 156 VDC
  - 9 VDC to 36 VDC

### **Cooling Concept**

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- Also available with conduction cooling in MEN CCA frame

**Please note that some of these options may only be available for large volumes. Please ask our sales staff for more information.**



For available standard configurations please see the [online data sheet](#).

## Product Safety

### Electrostatic Discharge (ESD)



Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Only store the board in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

## About this Document

This user manual is intended only for system developers and integrators, it is not intended for end users.

It describes the hardware functions of the board, connection of peripheral devices and integration into a system. It also provides additional information for special applications and configurations of the board.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

### History

Issue	Comments	Date
E1	First issue	2014-06-05
E2	Updated photos and front panel - cosmetics only	2014-06-30



## Conventions



Indicates important information or warnings concerning the use of voltages that could lead to a hazardous situation which could result in personal injury, or damage or destruction of the component.



Indicates important information or warnings concerning proper functionality of the product described in this document.



The globe icon indicates a [hyperlink](#) that links directly to the Internet, where the latest updated information is available.  
When no globe icon is present, the [hyperlink](#) links to specific elements and information within this document.

<i>italics</i>	Folder, file and function names are printed in <i>italics</i> .
<b>bold</b>	<b>Bold</b> type is used for emphasis.
mono	A monospaced font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".
comment	Comments embedded into coding examples are shown in <b>green text</b> .
IRQ# /IRQ	Signal names followed by a hashtag "#" or preceded by a forward slash "/" indicate that this signal is either active low or that it becomes active at a falling edge.
in/out	Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "from it the board or component".
	Blue vertical lines in the outer margin indicate sections where changes have been made to this version of the document.

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Since January 2005 the SMD and manual soldering processes at MEN have already been completely lead-free. Between June 2004 and June 30, 2006 MEN's selected component suppliers have changed delivery to RoHS-compliant parts. During this period any change and status was traceable through the MEN ERP system and the boards gradually became RoHS-compliant.



## WEEE Application

The WEEE directive does not apply to fixed industrial plants and tools. The compliance is the responsibility of the company which puts the product on the market, as defined in the directive; components and sub-assemblies are not subject to product compliance.

In other words: Since MEN does not deliver ready-made products to end users, the WEEE directive is not applicable for MEN. Users are nevertheless recommended to properly recycle all electronic boards which have passed their life cycle.

Nevertheless, MEN is registered as a manufacturer in Germany. The registration number can be provided on request.

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## Tables

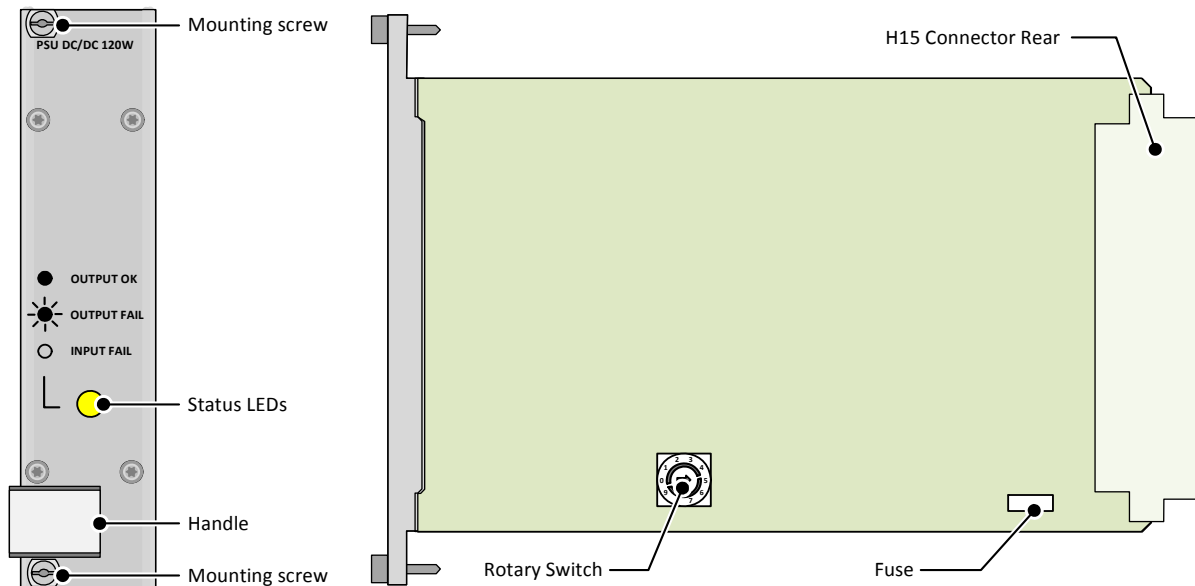
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# 1 Getting Started

This chapter contains a general overview of the board, and some information regarding the initial installation in a system.

## 1.1 Map of the Board

**Figure 1.** Map of the board – front panel and top view



## 1.2 Integrating the Board into a System



This chapter contains important information regarding initial installation of the PU20.

- ☑ The PU20 is hot pluggable, it is therefore not necessary to shut down the host system during installation, there will also be no significant interruptions to the system while installing or replacing this unit.
- ☑ Only operate the PU20 in a suitable housing, i.e. in such a way that no parts of the PU20 except the front panel can be touched.
- ☑ Make sure that enough convection airflow is provided.
- ☑ Do not remove any covers or other mechanical parts.
- ☑ The guiderails should be made of synthetic material and not touch any components.



To reduce the risk of electrical shock, do not disassemble or attempt to repair the power supply unit. Replace it only with the specified units from the MEN PSU family.

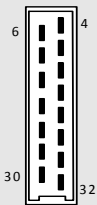
## 2 Connecting the PSU

The PU20 must be connected via the H15 connector at the rear of the unit.

Connector type:

- 15-pin H15 receptacle according to IEC 60603-2
- Mating connector: 15-pin H15 plug according to IEC 60603-2

**Table 1.** Pin assignment of rear H15 PSU connector

	6	Vo1+	4	Vo1+
	10	Vo2-	8	Vo1-
	14	5 V Standby	12	S+
	18	Vo2+	16	T1
	22	FAL#	20	Vo3+
	26	PUL, i	24	DEG#
	30	Vi+	28	PE
			32	Vi-

Note: Pin 32 is longer than the other pins.

**Table 2.** Signal mnemonics of PSU interfaces

Pin	Signal	Function
4	Vo1+	Output 1 pos (+5VDC)
6	Vo1+	Output 1 pos (+5VDC)
8	Vo1-	Output 1 neg. (GND)
10	Vo2-	Output 2 neg. (GND)
12	S+	Sense + (sense + 5VDC)
14	5 V Standby	5V Standby
16	T1	5V current share
18	Vo2+	Output 2 pos (+12VDC)
20	Vo3+	Output 3 pos (+3,3VDC)
22	FAL#	Input_Voltage_Good
24	DEG#	OverTemp
26	PUL, i	PS_ON#
28	PE	Prot. Earth PE
30	Vi+	Input pos.
32	Vi-	Input neg.



## 2.1 Parallel Mode

The PU20 can be used in parallel with up to six additional units from the MEN PSU family, which are easily scalable so that the required output power can be achieved. This not only increases the output power, but also allows balanced dissipation loss for all units, which leads to a better MTBF.

## 2.2 Redundant Mode

The PU20 can also be used in a redundant configuration. Redundancy maximizes the availability of a system in critical applications. In addition, reliability is enhanced as the modules are operating below the full output current rating, thereby reducing power dissipation and temperature rise. An output voltage fault, or the complete failure of one power supply will not affect the remaining PSUs.



The PU20 can be used in parallel with the [PU21](#), which is also available from MEN

## 2.3 Using an Integrated Shelf Controller

When using multiple PSUs, an independent shelf controller can be installed between two units. The shelf controller allows communication between units, and controls and supervises the speed of up to three cooling fans.

The shelf controller also provides a front panel display which displays the PSU supply status and hosts the power button.



For more information on the shelf controller, please refer to the host system manual. An overview of complete systems and documentation is available on the [MEN website](#).

## 3 Functional Description

The functions described in the following chapter depend on the firmware. This user manual describes the functions realized in the current MEN standard firmware.

### 3.1 Voltage Range Compliance

The PU20 is fully compliant with the voltage requirements for input voltages as specified by the EN50155 railway standards and provides the nominal input voltages 24, 26, 48, 72, 96 and 110 VDC. In addition, the PU20 also provides the possibility to extend the power input with an assembly option which allows an input range from 9 up to 36 VDC.

The PU20 is also compliant with the S-9401 Standard for Railroad Electronics Environmental Requirements, and provides a nominal input voltage of 74 VDC with a voltage range of 20 to 130 VDC.

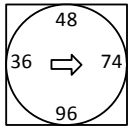
#### 3.1.1 Automatic Voltage Range Detection

The PU20 has an automatic voltage range detection for voltages 24, 72 and 110 VDC. The automatic voltage detection feature helps ensure automatic switch off when necessary, to avoid overloads and to protect the batteries, if used, against discharging when there is a drop in voltage in an electrical power supply.

#### 3.1.2 Manual Voltage Range Configuration

The automatic voltage range detection only detects voltages 24, 72 and 110 VDC. In order to compensate for the other voltages and cover the entire range, the PU20 also features a rotary switch which allows the voltages to also be manually configured to 36, 48, 74 or 96 VDC.

**Table 3.** Automatic and configurable voltage range overview

Rotary Switch	Configurable	Automatic Detection
	36 VDC	24 VDC
	48 VDC	72 VDC
	74 VDC	110 VDC
	96 VDC	

#### 3.1.3 Voltage Variations or Interruptions

Input voltage variations of  $0.6 \times U_n$  up to  $1.4 U_n$  for less than 0.1s, and  $1.25 \times U_n$  up to  $1.4 \times U_n$  for less than 1s, will not cause any functional disturbance.

The PU20 is compliant with class S2 of EN50155 power interruption and input short circuit regulations. Interruptions of up to 10 ms will not lead to any disturbances.

The PU20 is unconditionally stable under all load conditions, including capacitive load, see [Table 4, Capacitive Load on page 20](#)

### **3.1.4 Inrush Current and Reverse Polarity Protection**

The PU20 is equipped with an inrush current limiter to protect the components from damaging levels of inrush current at start up, which could lead to a reduction of equipment life.

The PSU provides a reverse polarity protection using active switchable transistors to provide minimum power dissipation.

## **3.2 Voltage and Current Management**

### **3.2.1 Output Voltages**

The output voltages of the PU20 are 12 VDC, 5 VDC and 3.3 VDC. The unit also supplies a standby voltage of 5 VDC with 5 W.

In the event of an internal fault, all output voltages are protected against an under or over-voltage of approximately 5%. All output voltages are also protected against overload and short circuits.

In the event of an overload, the output switches itself off. An output overload occurs with a load of 20% more than the maximum load which lasts longer than 1 second. An overload and short circuit will not cause any damage to the PSU.

### **3.2.2 Standby Voltage**

The standby voltage of 5 VDC is also available when all other voltages are switched off. After removal of the power, the +5 VSB standby voltage output remains steady for a minimum hold-up time of 16 ms, until the output begins to decrease in voltage. There are no other voltage disturbances at or following the removal of DC power. If the standby voltage is not used when the output voltages are switched off, the PU20 will have a power consumption of less than 0.5 W.

Standby voltage supports the following functions:

- Wake on LAN
- Wake on WLAN
- System Management Controller
- RTC application
- Suspend to RAM application

### 3.2.3 Load Sharing

The PU20 includes an active power sharing feature. This ensures that each of the paralleled PSUs contribute an equal share of the current to the load, which avoids any supply output from drifting higher than the others, and prevents premature failure of the power supply.

The maximum power output over all voltages, for the entire temperature range with convection airflow, is 120 W. The load sharing is between 12 VDC and 5 VDC output, including 3.3 VDC, which has a minimum of 35 W output power.

- The switch on behavior of the output voltages is independent of the load, so the dynamic load sharing has no effect on it.
- All output voltages have a maximum accuracy of approximately 1% of their nominal value.
- The maximum over and under shoot at all outputs is less than +4% / -2% of its nominal voltage.

Each output voltage of the PU20 is able to power up and operate within regulation limits, and with simultaneous capacitances as shown in the table below:

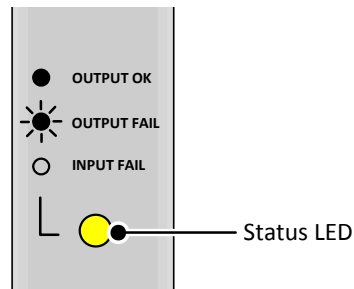
**Table 4.** *Capacitive Load*

Output	Capacitive load (µF)
12 VDC	10 000
5 VDC	10 000
3.3 VDC	10 000
5 VDC (standby)	5 000

### 3.3 Status Signals and LED

The PU20 provides three ports on the secondary side for switching output voltages, as well as indicating the event of an input power failure, output voltage failure or a fail-over temperature.

**Figure 2.** PU20 Status LEDs



The signal assignments are as follows:

**Table 5.** Status signals on the front panel

Signal	Function
Input Power Good	Indicates when input voltage is within the valid range, Indicates when input voltage falls below the under-voltage threshold
Over temperature output	Indicates when the temperature is within 15K of a thermal power shut down or output voltage fail
PS_ON# (Active low and TTL compatible)	Allows CPU to remotely control the power supply for soft on/off and wake-on-lan, TTL low: the three main DC output voltages are turned on. TTL high or open-circuit: the DC output voltages do not deliver current

The PU20 also provides a yellow LED which displays the correct output voltage range. The LED is located on the front panel of the unit.

The LED status assignments are as follows:

**Table 6.** Yellow status LED on the front panel

Yellow LED	Function
LED on	Output voltages are in valid range
LED blinking	Output voltages are not in valid range
LED off	Input voltage range is not valid

### 3.4 Isolation

#### 3.4.1 Isolation Groups

The PU20 provides the following isolated groups:

**Table 7.** Isolation groups

Group	Name
1	Primary power (voltage input)
2	Secondary power (all outputs and status ports)
3	Shield

#### 3.4.2 Isolation Voltages

The PU20 can withstand high voltages according to the following table:

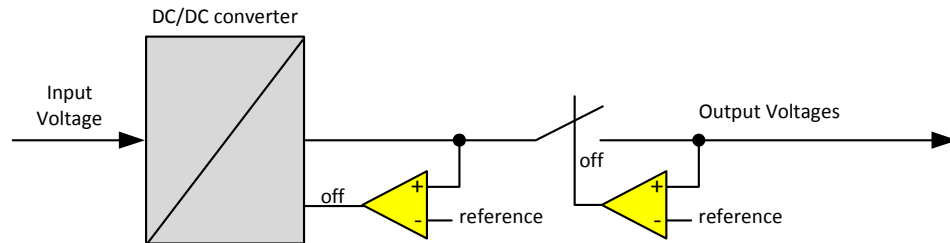
**Table 8.** Isolation voltages

Group	1	2	3
1	-	-	-
2	3100 VAC	-	-
3	3100 VAC	1000 VAC	-

## 4 General Information

The PU20 features a catastrophic failure protection function and voltage accuracy is consistently double checked. In the event of one unit failing, another unit will continue to check the accuracy and switch all voltages off if necessary, before any thermal damage is caused.

**Figure 3. Safety application**



Repeated switching on and off of the DC input voltage with a maximum load will not cause any damage to the power supply, nor will it cause the input fuse to blow.

The PU20 is compliant to the CPCI 3U standard and has a width of not more than 6HP.

A CCA version of the PU20 is also available, and is 3U and 5HP, compliant to the CPCI-S.0 specifications.

It is also possible to integrate CPCI-S 3U boards on both sides of the power supply unit without any additional space necessary between boards.

The PU20 is available in two models:

- Voltage range from 14.4 VDC to 156 VDC
- Voltage range from 9 VDC to 36 VDC

## 5 Appendix



### 5.1 Literature and Web Resources



PU20 data sheet with up-to-date information and documentation:  
[www.men.de/products/17pu20-.html](http://www.men.de/products/17pu20-.html)

### 5.2 Finding out the Board's Article Number, Revision and Serial Number

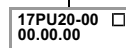
MEN user documentation may describe several different models and/or hardware revisions of the PU20. You can find information on the article number, the board revision and the serial number on two labels attached to the board.

- **Article number:** Gives the board's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the hardware revision of the board.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

**Figure 4.** Labels with the article number, revision and serial number of the board

Complete article number



Revision number



Serial number